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ABSTRACT

This paper offers some ideas on the types of behavior that can be considered precursors to language and that also lay the foundations for logic, mathematics, physics, etc. The paper posits the problem of whether a theory of language must be formulated before one can formulate a theory of language acquisition, or whether the reverse is true. The solution offered is the study of what is acquired at different ages, and how each stage relates to the others. This must be done by a selective study of the types of behavior that may lead to speech. After a definition of the essential features of language, prelanguage behavior may be studied. Among these behaviors is the development of what Piaget calls sensorimotor intelligence, i.e., modification and coordination of isolated action patterns present at birth. By the second year this behavior culminates in object-permanency, or the objectivization of the existence of objects and persons and their representation in the mind. A third behavior is communication, which includes vocalization, gestures, and postures. A final behavior is "babbling," which leads to the first word. The paper ends with speculation on the specific contribution of these four behaviors in the acquisition of the various levels of a particular language. (AM)

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Basic to Piaget's developmental psychology is the idea that to understand adult behavior and thinking it is necessary to explore how this behavior and thinking were built up during development. The most intriguing epistemological problem is indeed that of the construction of novelties: of the process by which human knowledge, despite detours into avenues that prove to be blocked, progresses from weaker to more powerful theories. However, there is no reason to attach particular importance to any one period in the construction of a particular field of knowledge; in fact, the lesson that should be drawn from Piaget's work is that there is never an absolute beginning any more than there is an absolute end. When Piaget traces the beginnings of logic back to the action patterns of babies in their first year of life, this does not mean that that particular phase of the construction of logic is the most important for our understanding of logical thinking in general. The study of the transition to formal logic in the twelve-year-old child or the study of the history of logic may help us to understand processes at work during other phases. Moreover, even the very first action patterns of babies are preceded by embrylogical phases: and animal studies, especially of primates, also contribute. It is often possible to grasp the essential nature of a scientific concept by studying children -- provided, of course, that one knows what to look for. Thus Piaget showed the importance of one-to-one correspondence for the concept of number: this one-to-one correspondence is grasped by children of about five-years-old and is part of the idea of barter in so-called primitive society. It can be traced further back to the baby who throws every single toy out of his play-pen and starts screaming wher his universe of objects is reduced to zero. Cantor rediscovered the one-to-one correspondence principle in mathematics and used it to found set-theory.

Though it may be true that, in Chomsky's words, there is not much sense in asking how language is acquired before we know far more about what is acquired, according to Piaget's conceptions there is not much chance of finding out what is acquired -- in the sense of understanding something about the nature of human language -- unless we know something about its acquisition. This would lead to the pessimistic position that it is impossible to construct a theory of language without first constructing a theory of acquisition and vice versa. Such a position, however, is unduly defeatist and a simple way out of this circuitous cul-de-sac might be to look closely at what is acquired at different ages and how earlier stages relate to the next ones. This, however, cannot be done without some discrimination. Not all behavior that precedes the kind of behavior developmentally that we want to understand is important for such understanding.

Though it has been noted that many heroin users first smoke pot, it has also been noted that all alcoholics first drink milk. Before infants begin to talk, they develop in many ways and it has to be decided what kinds of development are of importance for the preparation of language behavior. Before they start talking, infants also usually learn to eat solid food and to crawl, and though it is not excluded that an analysis of these acquisitions could throw some light on the language acquisition mechanisms they would not be among the most promising starting points.

Obviously, before selecting for study certain types of behavior that may develop into language, some thought has to be given to what should be considered essential features of language. Most linguists would agree on such features as discontinuity of elements, duality of patterning, semanticity, and productivity. Though from such a list it is not possible to determine for an individual baby the exact moment where speech starts, there is without doubt a period where the baby does not yet speak, just as there is a period where he does speak; and often there is also a period where he is "ready to start speaking any moment now." Clearly, a year or so of development preceded the start of speech. Taking for granted a certain number of necessary conditions such as physical maturation in general, absence of auditory or articulatory deficiencies and presence of a sufficient input of more or less acceptable quality, one can study a number of behaviors that precede language in a purely temporal sense and that can be considered as preparing language in the sense of a functional continuity.

Among the capacities that develop during the first year of life and that deserve to be closely looked at as precursors to language is the development of sensorimotor intelligence -- intelligence in action. Speaking and understanding are undoubtedly cognitive activities and though it has often been said that one need not be intelligent to learn to talk, severely retarded children only acquire the rudiments of language and moreover the onset of language is delayed until their level of cognition reaches that of a normal 18-months old baby. According to Piaget -- and his conception seems to be amply demonstrated by his observations and experiments -- the foundations of logical thought as well as of thoughts about physics are laid during this period. Very briefly, and with inevitable variations, all babies are born with a small number of isolated behavior patterns that are ready to function at birth (e.g. sucking and grasping) and with the human tendency to try to organize and explore ever greater parts of the environment that is accessible to them. Babies not only suck their mother's breast, but very soon will suck their fingers, a

corner of the blanket, a toy, etc. These action-patterns have to be modified according to the object -- one does not suck a finger in the same way one sucks a rattle. Moreover, very soon these action-patterns become combined and coordinated (at first the baby can look at or grasp something, only later can he look at what he grasps and grasp what he is looking at). Such combinations create new action-patterns and the baby's experiences become organized in two directions: on the one hand he explores objects and gets to know their properties (things are good or bad to eat, hard or soft to touch, etc.) though, until the second year, there is no sign that the child regards properties as something belonging more or less permanently to the object itself; they only exist when linked with his own actions. On the other hand, new experiences, which may be haphazard (such as accidentally hitting the wall with a toy and being surprised by the noise it produced) lead to new coordinations needed to obtain interesting effects. The first type of novelty -- learning the properties of objects -- leads to what later will be knowledge about the physical world, whereas the second type -- new coordinations and generalizations -- leads to what later will become knowledge of logic and mathematics.

This intelligence in action culminates, by the end of the first year or the beginning of the second, in what Piaget has called object-permanency. Instead of only providing occasions for actions or means of satisfying desires, objects and people now become things to be known, that have an objective existence apart from the baby's own activities or desires. A simple experiment in which the experimenter hides a toy in one place or successively in different places in front of the child's eyes makes it possible to distinguish several stages in the elaboration of object permanency, a concept that combines the two types of knowledge referred to above. On the one hand objects now have acquired their first permanent property -- that is, their objective existence or retrievability. (The great success of peek-a-boo games with two- and three-year-olds is certainly in part due to the fact that the link between disappearance and reappearance is still a fairly recent cognitive conquest and that there is still a little bit of surprise attached to the hiding game.) On the other hand, objects are retrievable because even after being hidden in different places, the baby can recapitulate and coordinate the different displacements they have undergone, and this coordination of movement in space constitutes the first structure to resemble a mathematical group: things and people (including the baby himself) can go from A to B and if they go from B to A they come back to their point of departure; they can also go from A to C and from C to B, reaching B by different

routes. The principles of addition, reversibility and identity are first established in the movement of well-defined objects in space. This intellectual conquest inaugurates a new period in the child's development. Now that things and people have acquired this objective existence the child becomes capable not only of recognizing them, which he could already do well before his first birth day, but also of evoking them in their absence. This capacity, that of representation, is essential to thought, which becomes liberated from the here and now and allows a gradual interiorization of action-patterns into conceptualizations.

Representation is another candidate for a language precursor, since language is one of the means by which events can be represented. Piaget traces the capacity of representation back to imitation, which starts much earlier, in the very first months of life.

The first imitations occur when somebody performs a movement or utters a sound which already belongs to the baby's repertoire, such as waving both arms or saying something like "grararara." But in a sense, imitation goes even further back than that: to grasp something intentionally, one's hand has more or less to imitate (i.e. accommodate to) the shape of the object to be grasped, since for a fairly large object, such as a teddybear's leg, the hand has to be opened wide, but for other objects, such as Mummy's hair or a necklace, the baby hand can be half opened and only needs to be snapped shut to grasp the object. Only gradually does the child develop his imitatory capacities: to imitate an activity he does not yet have in his spontaneous repertoire is still more difficult; to imitate somebody or some event in its absence, i.e. sometime after the model has disappeared is already truly representational behavior, and does not happen before object permanency is attained.

These different stages of imitation, which prefigure representation, constitute another developmental sequence, parallel that of sensorimotor intelligence, of a special kind of behavior; imitative behavior does not bring about any tangible result and does not seem to have a specific goal, but it is a special form of contact between self and others and leads to interiorization.

When imitation in the absence of a model becomes possible, true representation starts, observable in different types of behavior: the child begins to behave "as if": he will pretend to be asleep and burst out laughing when his mother acts as if she believes him; he will play with a box and a block and from his behavior it will be clear that the up-ended box represents a garage and the block a car; at other moments during this same period the child will solve a problem

through a kind of actual motor representation of what is to be done. Piaget observed (Formation du Symbole, 1956, Delachaux, Neuchatel) how his daughter when trying to open a matchbox stopped acting, looked at the box and opened and shut her mouth several times -- almost immediately afterwards she succeeded in opening the box. Soon afterwards, representations without exterior action become possible, and the child will perform intelligent actions which can only be explained if we assume the existence of some kind of mental image (cf. the example from Jacqueline, Piaget's daughter).

A third type of behavior that would seem to prefigure language is communicative behavior. Unlike representation, communication starts very early in life. An early opposition in the baby's cries indicates contentment or discontent: the first is signalled by a low, non-nasal, relaxed sound ('raragrarere') whereas the second is signalled by a high, nasal, tense sound ('ẽin'). Though it is difficult to determine when such cries become intentional communications, most observers agree that around the age of 7 months several such oppositions are present, and that the baby's behavior at that period clearly indicates that communication has become intentional. To the content-discontent opposition are now added acceptance-refusal, demand-offer, recognition-surprise. An experimental study of Dr. Ricks (London, 1973) shows that mothers recognize the meaning of these sound patterns whether they are uttered by their own babies or by others, irrespective of whether the babies hear Hindustani, Spanish or English spoken around them. This tends to show that these communicative cries and vocalizations are universal and universally understood: they signal very efficiently the baby's interior state or his reaction to an event. They are well installed before any real representation is possible. Moreover, these vocalizations are accompanied by postures and gestures, such as reaching out towards an object, curving tensely backwards, turning the head, etc. A remarkable study by J. Montanies shows that such gestures become stylized or ritualized, and that children between the ages of 2 and 3 use them amongst each other in their social contacts: solicitation, imitation, menace, appeasement and request are signalled by ritualized postures, gestures, and facial expressions.

Finally, there is still another type of behavior which can be regarded as a presursor to language, and that is babbling. Babbling also undergoes a noticeable development between birth and the onset of language -- a development that is would be presumptuous for me to talk about at Stanford. Descriptions of this development in terms of the sounds produced seem to show a very close resemblance between babies, whatever language they hear spoken around them, at

least up to a certain age. They also show a close link with physiological development, such as the muscular tonicity of the lips and tongue, which at a certain age allows the production of vowel-like sounds such as ou, ü and o, and consonant-like sounds such as t's and f's. At the same time they show the influence of both more general physiological development and of psychological advances: sounds that are easily perceived visually, such as p' or b's and o's seem to appear at about the time that the baby graduates to a sitting position which gives him better opportunity to look the adult in the face, and this also coincides with the time the infant becomes capable of imitating something that he does not yet have in his own repertoire. From there on, it seems that the phonological system of the mother tongue is slowly built up, sequences get longer, the intonational pattern changes, and one day the famous first word appears.

Language, in the commonly accepted sense of the word, serves the function of communicating and representing what the speaker knows, and this function remains the same throughout life. On the other hand, language also has structure and content: both of these change as the child grows older, and both structure and content are closely bound up with knowledge, i.e. knowledge of the content to be expressed or understood, and knowledge of the complex system which is the means of expression.

These four types of behavior -- cognition, representation, communication and babbling which I have very briefly sketched, certainly seem preparatory to language. But how are these different strands woven together into the learning of the intricate pattern of a particular language? If we suppose that during the pre-verbal developmental period the baby acquires a universally valid heuristic system which allows him to start his career as a speaker of any one of the languages in the world, what role do these different acquisitions play in the building up of heuristics? There are similarities as well as differences amongst cognitive, communicative, representational and babbling behaviors. All of them satisfy the condition of universality since they do not seem to depend on the input of any particular language. Cognition, representation and communication do not even depend on any (spoken) language input, as the observation of deaf-born babies shows. Babbling, of course, does depend on language input, at least from a certain age onwards, and it seems to become particularized according to the language the baby hears spoken around him before the onset of speech. Sensorimotor intelligence, communication and babbling are all well launched on their developmental warp before language starts; but representation is contemporaneous with, or only slightly precedes, the first words. Cognition, and representation

in close connection with cognition, continue developing many years after speech has started; babbling, on the other hand, stops quite soon after language acquisition starts. Pre-speech communication is something very different from verbal communication. The vocal oppositions and different postures and gestures that can be observed at a very early age signal and later communicate the baby's reactions to interior or exterior events: they do not express the event or the objects and persons involved in the event. However, this direct person-to-person communication without expression of the third term, reality, continues later in life: facial expressions, gestures and postures still serve this communicative function in adults, and so do interjections, grunts, shouts, clicks, whistles and finger-snapping. In hearing children, a very different vocal system may serve for the direct communication of events (in contrast to the transmission of reaction to events) and in deaf-born children a different system of gestures will serve this function. When it comes to wondering what pre-verbal skills direct communication contributes to the construction of the hypothetical heuristic system which makes language acquisition possible, I would be tempted to conclude that it does not contribute any structural components. Its role could well be limited to giving the baby the "idea" of communication: "If I do something, you react;" and "If I do it right, it works." As such, this type of communication may well be no more than an incentive to speech which is an entirely different type of communication. There is, however, one feature of preverbal communication that may contribute something more, and that is the existence of the vocal oppositions which serve to express the baby's reactions: could these contribute to the constitution of the phonological system with its distinctive features?

Representation, of course, contributes an essential ingredient to the onset of language: the capacity to indicate an absent object or event by another object (as in symbolic play) or by gestures and later drawings. Representational gestures are very different from communicative gestures such as the stretching out of the hand when asking for something. A good example of a gesture of representation is given by the child who, at the age of 17 months, one day saw a butterfly fluttering in the corner of a window; a week later the child visited the same house, went straight to the same window, looked up and started waving her arms up and down -- representing the absent butterfly by this gesture. Of course, there remains an important difference between such gestures and words. Words do not resemble the reality they represent. In make-believe play, however, we do see a slow progression towards the representational use of objects that resemble the objects represented less and less; at a certain age, a bit of wood may be used in turn for a comb, a toothbrush, a pencil, a spoon, etc.

The precursor of representation, pure imitation in the presence of a model, does not seem to play an equally important role; it seems to play a complementary and parallel role to that of pre-verbal communication. Whereas the latter occurs with a specific, practical aim in pre-speech behavior, imitation in the presence of the model lacks such an aim, but it does introduce the idea of "what you do, I can do too," and "if I do it right, it pleases."

The development of sensorimotor intelligence seems to be a serious candidate for the provision of structural components in the heuristic system. First, it provides the meaningful content of language. Several pieces of research have noted that the basic action patterns by which the baby relates one object to another are also found amongst the earliest semantic and syntactic relations in his utterances. As soon as the child goes beyond what Piaget has called "jugements d'action" and Gruber "performatives," to Piaget's "jugements de constatation" and Gruber's "reportatives," relations such as actor-action, action-patient, possessor-possession, gift-receiver and many others can be detected in the child's utterances when we also take his actions and the general situation into account. However, this does not explain the syntactic forms such utterances take, though it explains their semantic content. A second, and maybe more important contribution of the sensorimotor cognitive structures may be sought in the far more abstract aspect of what Piaget calls the action-pattern coordinators. Quite apart from the specific content and the relationships they produce, action patterns can be combined in different ways: they can be added to each other (without being ordered, i.e. ab or ba), they can be ordered in temporal succession (ab, bc, abc), one action pattern can be subordinated to another, or embedded into an already established sequence (ab, axb), etc. I would like to propose that these very general coordination mechanisms contribute the main structural components of the heuristic system which the child will use to build up his syntactic structures. The fact that the general coordinations are difficult or impossible to isolate from the content of the action patterns does not appear too bothersome; at the linguistic level, the same difficulty arises when semantics and syntax have to be differentiated.

Finally, there remains the role of babbling. Its role would seem obvious: it is going to contribute to the construction of the phonological rules. In contrast to cognition and representation, which are very closely linked, babbling seems to follow its own particular developmental line, though at a certain period it links up with imitation. However, from the little I know about the work done on babbling, it seems as if the way the baby constructs phonological rules has

structural features in common with the very general principles of cognitive development, e.g. the construction of patterns in sound sequences.

The conclusion of this highly speculative paper would in a sense seem to coincide with a pronouncement by Louis Carini (Current Anthropology, Vol. 14, 1-2, 1973), that "language is a mutation, one that arose with the chance conjunction of babbling in babies and a brain that could represent symbolically." Or, in other words, rather than talking about "From babbling to speech" I have talked about "From sensorimotor cognition plus babbling via representation to language."